pared with that of handling one of 100,000 cubic feet, can hardly be estimated. The risk in a high wind of the smaller balloon is vastly less than of the larger. Every way the smaller balloon presents advantages over the larger. The first cost of a balloon of 20,000 cubic feet would be $600. The cost of a half charge of gas need not be over $30, and may be less. It is hoped that the balloon will be sufficiently tight to hold its gas for a long period. In Europe balloons have been made with gold-beaters' skin that have leaked only ¼ of 1 per cent in 24 hours. I think the leakage of a cloth balloon when properly made need not be over 4 or 5 per cent, but the figures in this country are exceedingly meagre and unsatisfactory. After an ascension it will be a very simple matter to conserve the gas, and, if wished, an addition may be made at the landing-point with gas from a flexible holder, which may be easily transported from point to point.

An interesting problem presents itself as to the behavior of the gas in a rapid ascent or descent. Theory indicates that in a rapid expansion dry gas will cool 1° F. in 186 feet ascent, so that at 25,000 feet the temperature would be about 130° lower at the centre of the balloon than at the outside air, provided the ascension was quick enough to prevent the heat from striking in. Now experience in balloon ascents shows that the gas in a balloon is invariably *warmer* than the outside air. Exactly the reverse is true in a rapid descent, both as regards theory and practice. Whether this is due to the fact that the envelope retains its heat or not, it still remains that we have here apparently a means of making our ascensions with the loss of little or no gas at the valve. At the highest point our gas will be cooled and lose its buoyancy, which allows a fall in the balloon, which is always greatly accelerated as we approach the earth, and after landing the balloon may be anchored till the sun's heat has warmed the gas, which will enable another trip with the same gas.

The risk in such ascents has been greatly exaggerated by some from the serious and often fatal accidents that have attended jumping with parachutes and ascending in hot-air balloons. The modern balloon, with its very long drag-rope and rip-cord, are very safe. Even in case the balloon should burst, the envelope catches in the netting and acts like a parachute in breaking the fall. Mr. Wise, the veteran, once ascended to the height of a mile and purposely exploded his balloon in order to show that there was no great risk in such an adventure. In one case, Mr. King and a married couple were in a balloon which exploded at the height of a mile, and without serious consequences It should be noted that a new balloon will not explode. Glaisher reports having ascended with a balloon full of gas at the rate of 4,000 feet per minute; this was a remarkable feat. It is not the intention to ascend faster than 1,000 feet per minute, and at this rate the danger of bursting is almost nothing.

Some may think that such observations may be made at vastly less risk, expense, and discomfort on mountain tops. Undoubtedly there are some observations of temperature that may be made in this way, but even in this case we cannot tell just what effect the summit will have. Observations of rainfall, clouds, electricity, etc., are entirely impossible on mountain-tops, for the reason that these have a peculiar action of their own entirely different from that of the free air. It seems probable that the mountain acts like a point in the atmosphere from which there is a continuous discharge of electricity, as in the case of a point on the conductor of an electric machine.

The exploration of the atmosphere cannot be carried on in Europe to as good advantage as in this country, for the reason that they do not have the normal low areas and high areas travelling at some velocity that we have. The conditions of the atmosphere are so different in the two countries that we must make our own researches. I trust I have shown the great need of such exploration. I know of no endowment of $5,000 or $10,000 that would pay so rich and immediate a harvest as this for ballooning. Thousands are spent in visiting the inhospitable north, while a field just at our hands, which may be explored at vastly less expense and risk, and which promises immeasurably greater returns, is left unexplored and unvisited.

March 31, 1893.

LOSS OF DRY MATTER BY THE SPROUTING OF CORN-SEEDS.

BY E. H. FARRINGTON, CHEMIST, AGRICULTURAL EXPERIMENT STATION, CHAMPAIGN, ILL.

SEEDS of the corn-plant were placed in damp cotton and left to sprout in the dark for nine days. Four of these seeds partially sprouted, then moulded, failing to develop further. They lost by this treatment 9 to 18 per cent of the dry matter in the original seed.

Two seeds, under the same conditions for nine days, sprouted and developed a corn plant. The root and stem of these plants each measured two to three inches, and their weight was from three to three and one-half times that of the original seed. It was found, however, that when the water was dried out of these young plants the dry matter in them was 20 and 31 per cent less than the seed contained.

Several estimations were made of the per cent of water and dry matter in a sample of corn. These results were used for estimating the weight of water and dry matter in the corn which was taken from the same sample and sprouted.

Details of Weights in Grams.

	Dry Matter.	Water.	Total.
Weight of seed before sprouting.........	0 271	0.042	0.313
After nine days sprouting in damp cotton, plant with seed attached, weight..	0.187	0.747	0.934
Gain or loss of plant over seed...........	− 0.084	+ 0.7 5	+ 0.6[illegible]1
Per cent gain or loss was of weight in the seed..............................	− 31.0	+ 1680	+ 198
Duplicate observation gave.............	− 19.8	+ 1945	+ 239

This shows that in sprouting the white plant had taken up water but lost in dry matter.

This experiment was repeated June 3, 1892, by sprouting the seed in the soil of a corn-field instead of cotton. One week after planting, four of the plants were dug up. They were about two inches above ground and had two green leaves. The shell of the seed still clung to the plant. The root was about five inches long, making a total length of about ten inches from tip of leaf to end of root.

The weight of these green plants, free from soil, was about four times that of the seed planted, but they contained from 58 to 79 per cent only of the dry matter in the original seed.

During the week these seeds were growing the climatic and soil conditions were ideal for corn.

Details of Weights and Measurements.

Plant No.	Weight in Grams. Seed. Dry Matter.	Weight in Grams. Seed. Total.	Weight in Grams. Green Plant.	Measurement of Plant. Inches. Tip of Leaf to Seed.	Measurement of Plant. Inches. Above Ground.	Measurement of Plant. Inches. Roots.	Dry Matter. In Plant.	Dry Matter. Per cent of that in Seed.
1	0.416	0.479	1.633	4	2	5	0.331	79.3
2	0.357	0.412	1.447	4½	2	5	0.210	58.8
3	0.347	0.450	1.549	3½	2	4	0.273	78.6
4	0.393	0.457	1.454	1½	3½	4	0.310	78.2

Two weeks after the seed had been planted, five plants were cut at the surface of the soil, and the weight and measurements of each plant above ground was compared with the weight of the seed. This shows that corn-plants, having a height of ten to fourteen inches above ground, weighed when green four to eight

times as much as the seed, but the dry matter in these plants was from 86 to 130 per cent only of that in the seed planted.

Details of Weights and Measurements.

Plant No.	Weight in Grams.			Height of Plant above Ground. Inches.	Dry Matter.	
	Seed.		Green Plant.		In Plant.	Per cent of that in Seed.
	Dry Matter.	Total.				
1	0.378	0 437	3 235	14	0 493	130.4
2	0.346	0.400	1.79)	9½	0.3 0	86.7
3	0.395	0.456	2.470	11½	0.435	110 1
4	0.404	0.466	2.610	11	0.348	86.1
5	0.424	0.490	3.540	12	0.437	103.0
Growth above ground of two plants three weeks after planting.						
1	0.348	0.402	16.60	21½	1.826	524.6
2	0.413	0.477	18.60	20½	2.045	495 4

ELECTRICAL NOTES.

Some of the practical results of Dr. Sumpner's work on photometry were alluded to in a previous note. As the Proceedings of the Physical Society are not generally accessible, and most of the abstracts given are rather brief, it may be worth while to give a short account of some of the more theoretical results.

The first is the practical demonstration of the very approximate accuracy of the cosine law of reflection of such substances as white paper, tracing cloth, and white cloth. From this follows the remarkable result, confirmed by experiment, that placing a piece of white paper behind a source of illumination more than doubles the illumination at a point normal to the plane of the paper, while the placing of a mirror in the same position does not quite double it. The reason of this is at once seen to be the fact that the reflecting power of white paper and the mirror are about the same, but that, of a given amount of light falling on the paper, in consequence of the cosine law, the greater part is reflected normally to its surface, whereas in the case of the mirror, the absorption of the glass is greatest in the case of the light falling perpendicularly to it, and so the greater part of the light is given off in directions which are not normal to the surface.

In the discussion following, it was pointed out that no known shape of the roughnesses would lead to the mathematical deduction of the cosine law, so it is probable that the phenomenon of diffusion of light is of a somewhat more complicated nature than is generally supposed. It is to be hoped that the definitions used by Dr. Sumpner will be generally employed in photometric work. They are as follows:

1. Candle-power.— The candle-power of a lamp is measured by the ratio of the illumination of the light considered, to that of a standard candle, both sources being at the same distance from the object illuminated.

2. Illumination.— The unit of intensity of illumination is that given by a standard candle at a distance of one foot.

3. Unit quantity of light.— Unit quantity of light is the quantity of light which falls on a surface of one square foot placed at a distance of one foot from a standard candle, and so that a normal drawn to the surface at any point, passes through the source of light.

The name candle-foot is given to the unit quantity of light.

From the definition, a source of light, candle-power X, gives out a total quantity of light equal to 4π candle-foots.

4. Brightness.— This definition only applies to solids which become sources of illumination, either through incandescence, as heated platinum, or through reflection, as paper exposed to sunlight, i.e., only to such substances as obey the cosine law.

A surface has unit brightness when a point at a distance of one foot from a surface of one square foot of the substance, and so placed that a normal drawn from any point of the surface passes through the point, is illuminated with unit intensity.

From the definition, it follows that the total quantity of light given off by one square foot of surface of brightness, X is πX.

One interesting result, following from the considerations which lead to the last of these definitions, is that given by Dr. Sumpner, as it affords an explanation of snow-blindness.

The total quantity of light reflected from the snow will nearly equal the amount which falls on it. Therefore, if C be the intensity of the illumination of the sun at the surface of the snow, the brightness of the snow at a distance of one foot from it will be $C|\pi$. Therefore, if the observer is standing so that the snow-field subtends a solid angle of 90 degrees, we may easily find that the illumination at the point where his eye is, is nearly C, or that the effect is nearly the same as if he were looking straight at the sun. R. A. F.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Early Attempts at Storm-Warning.

IN reading Haweis' "Music and Morals," I found on page 368 a statement of interest to meteorologists. Writing of the famous Strassbourg tower, he says: "The second bell, recast in 1774, is named 'The Recall' or 'Storm-Bell.' In past times, when the plain of Alsatia was covered with forests and marsh land, this bell was intended to warn the traveller of the approaching storm-cloud as it was seen driving from the Vosges Mountains towards the plain."

Probably Kopp, Günther, van Bebber, or Hellmann, in their records of antiquarian research, have mentioned this early attempt at storm-warnings, but I do not remember having seen anything about it. FRANK WALDO.

Princeton, N.J., April 5.

Pre-Historic Remains in America.

IN his letter in *Science*, March, 31, under the above title, Professor Cyrus Thomas misunderstands the quotation which he makes from my "American Race." He observes, "If the settlement was at one point by one race, and this race was never influenced by another, it is difficult to imagine in what respect the moulding process acted." Is it? Plainly the moulding process acted by modifying the intrusive population to another and a fixed racial type by long subjection to an environment to which previously it had never been exposed. Nothing is better recognized than such a process; it is taken for granted by all writers, as, for instance, by Dr. Braislin in the same number of *Science* in which Prof. Thomas's letter appears; and why such an objection should be offered to my statement, it is even more "difficult to imagine."

The general theory advanced by Professor Thomas of a fundamental difference between the civilizations of the Atlantic and Pacific groups, is one for which I have never found any evidence. He must know that the ancient civilization of the Mississippi Valley offers as strong, if not stronger, traits of analogy to that of Mexico and Yucatan than does that of the Haidahs. Consider the designs shown on the engraved shells, so well shown in the beautiful monograph of Holmes, or the copper work of the mounds of Ohio and Georgia! In view of such evidence, how could Prof. Thomas write, that "no such resemblance to those of the Atlantic slope is observable?" Is he not also aware that both the Nahuatl and Maya languages trace their affinities exclusively to the eastern and not to the western water-shed of the continent